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INKJET RECORDING SHEET

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Inventor(s): NAKADA
MASAHIRO;
OKAWA AKANE;
TAJIRI KOZO +
Applicant(s): OJI PAPER CO +

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Abstract of JP 2004001463 (A)

PROBLEM TO BE SOLVED: To provide a recording sheet for an inkjet printer which has a photographic printing paper-like gloss, is excellent in both ink absorbing speed and amount of ink absorption, and does not generate failure in film forming caused by cracking during drying in a manufacturing process of an ink receiving layer. ; **SOLUTION:** On at least one face of a substrate, a porous ink receiving layer comprising fine silica with a mean particle diameter of at most 0.5 [μ]m and

manufactured by a wet process, an electrolyte and a polyvinyl alcohol, is provided and in addition, a gloss exhibiting layer is provided. ; COPYRIGHT: (C)2004,JPO

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1 INKJET RECORDING SHEET

Inventor: NAKADA MASAHIRO ; OKAWA
AKANE (+1)

EC:

Applicant:
OJI PAPER
CO

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[Claim(s)]

[Claim 1]

An ink jet recording sheet comprising:

Minute silica by which mean particle diameter is manufactured with wet process which is 0.5 micrometer or less at least at one side of a base material.

A porous ink receiving layer containing an electrolyte and polyvinyl alcohol is provided, and also it is a gloss development layer.

[Claim 2]

The ink jet recording sheet according to claim 1 whose 75-degree specular gloss (JIS P8142) is not less than 40%.

[Claim 3]

The ink jet recording sheet according to claim 1 or 2 in which this base material is a non-infiltrative base material.

[Claim 4]

The ink jet recording sheet according to claim 3 whose 75-degree specular gloss (JIS P8142) of this non-infiltrative base material is not less than 60%.

[Claim 5]

The ink jet recording sheet according to any one of claims 1 to 4 which is a secondary particle with a mean particle diameter of 8 nm - 500 nm which primary particles in which these minute silica is the mean particle diameter of 3 nm - 100 nm condense.

[Claim 6]

The ink jet recording sheet according to any one of claims 1 to 5, wherein specific surface area and pore volume by a nitrogen absorption method of this minute silica fill (the

formula 1).

(Formula 1) Specific surface area (m^2/g) $< 730 - 600 \times$ pore volume (ml/g)

[Claim 7]

The ink jet recording sheet according to claim 6, wherein specific surface area and pore volume by a nitrogen absorption method of this minute silica fill (the formula 2).

(Formula 2) Specific surface area (m^2/g) $> 450 - 600 \times$ pore volume (ml/g)

[Claim 8]

The ink jet recording sheet according to claim 7, wherein specific surface area of this minute silica is furthermore $150 - 300 \text{ m}^2/\text{g}$ and pore volume is $0.5 - 0.9 \text{ ml/g}$.

[Claim 9]

The ink jet recording sheet according to any one of claims 1 to 8 which this minute silica makes condense active silica, and is manufactured.

[Claim 10]

The ink jet recording sheet according to any one of claims 1 to 9 in which this electrolyte is chosen from alkali metal salt or alkaline earth metal salt and which is a kind at least.

[Claim 11]

The ink jet recording sheet according to claim 10 in which this electrolyte is a strong acid salt of an alkaline metal.

[Claim 12]

The ink jet recording sheet according to any one of claims 1 to 11 whose content of this electrolyte is a rate of 0.05 to 5 mass part to this minute silica 100 mass part.

[Claim 13]

The ink jet recording sheet according to any one of claims 1 to 12 whose saponification degree of polyvinyl alcohol is not less than 90%.

[Claim 14]

The ink jet recording sheet according to any one of claims 1 to 13 whose degree of polymerization of polyvinyl alcohol is 1700 or more.

[Claim 15]

The ink jet recording sheet according to any one of claims 1 to 14, wherein this porous ink receiving layer has two peaks or one broad peak which has a shoulder in the range of pole diameter (6 nm - 150 nm) in a pore distribution curve measured by the mercury porosimetry.

[Claim 16]

The ink jet recording sheet according to claim 15 whose absolute value of a difference of a mode pole diameter and a median pole diameter in this pore distribution curve is not less than 10 nm.

[Claim 17]

The ink jet recording sheet according to claim 15 or 16 whose pore volume in the range of pole diameter (6 nm - 1 micrometer) of this porous ink receiving layer is 0.5-2.0ml/g.

[Claim 18]

The ink jet recording sheet according to any one of claims 1 to 17 whose film surface pH of this porous ink receiving layer is 5-10.

[Claim 19]

The ink jet recording sheet according to any one of claims 1 to 18 which forms this porous ink receiving layer when pH containing this minute silica, this electrolyte, and polyvinyl alcohol dries seven or more distemper after coating to a base material.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to an ink jet recording sheet. In particular, it has the gloss of a photographic-printing-paper tone, has high ink absorption velocity and ink absorption, and is related with the ink jet recording sheet which a crack does not generate in an ink absorbing layer.

[0002]

[Description of the Prior Art]

Since the ink jet recording method can do color printing cheaply with a simple device, it is a recording method suitable for a personal youth.

It has spread through the printing use in an office or a home quickly.

By having attained full-color-izing and high resolution-ization in recent years, image quality is improving quickly, attracts attention as an easy output form of a color picture, and is considered to be one of the most leading methods as substitution of a film photo. Therefore, the requests to the ink jet recording sheet which has the high definition and high gloss which are equal to a film photo are mounting.

[0003]

Since the ink used with an inkjet method contains a lot of solvents, in order to obtain high printing density, it needs to carry out the regurgitation of a lot of ink. Therefore, the material which can fully absorb the ink breathed out as an ink absorbing layer provided on an ink jet recording sheet is required. Since an ink drop is breathed out continuously, if the following drop is breathed out before the first drop is absorbed, it will become a cause of a blot or concentration unevenness and a clear picture will not be acquired. Therefore, as an ink absorbing layer, it is required that it should have a quick rate of absorption with an absorbed amount. Various performances, such as the drying property of not only the demand to the above-mentioned image quality side but ink, the water resisting property of printing quality, and the preservation stability of the picture in the case of carrying out a mothball, are required.

[0004]

In order to fill the above demands, many ink jet recording sheets which provided the ink absorbing layer of the resin system or a paints system are proposed and marketed. Generally a resin system receiving layer carries out coating of the solution of water soluble resin, such as polyvinyl alcohol,

a polyvinyl pyrrolidone, a water soluble cellulose derivative, and gelatin, to a base material, dries and is formed. Since transparency is high in a resin system receiving layer, while there is the strong point in which printing density is high and gloss is also high, there is a fault that image quality is bad since the rate of absorption of ink is slow, and the drying rate of ink is slow and a water resisting property is also bad. Therefore, it is difficult to acquire print quality equivalent to the film photo demanded in recent years, and, these days, the paints system receiving layer described below is becoming in use.

[0005]

A paints system receiving layer is formed by adding water soluble resin, such as polyvinyl alcohol and a cellulosic, as binder resin to paints, such as silica, alumina, quasi-boehmite, calcium carbonate, and kaolin. What primary particles condense and forms secondary particles as a gestalt of the above-mentioned paints is used preferably. In such a paints system receiving layer, in order for ink to be quickly absorbed by capillarity by the opening between the primary particles of paints, and between secondary particles and to form a picture in it, image quality is good and the ink drying characteristic of image quality is also good.

[0006]

The paints generally marketed have many things with the secondary particle diameter of greater than 1 micrometer, and since the opening between big secondary particles is formed when these are used for a paints system receiving layer, its ink absorbency is high. However, since secondary particle diameter is large, the smoothness of the surface of a receiving layer is low and its gloss is low. Therefore, for the purpose of obtaining the high gloss of the photographic-printing-paper tone called for in recent years, it is unsuitable. Since the transparency of a receiving layer is low, there is also a fault that printing density is low. For example, the ink absorbing layer containing the weak acid salt of an alkaline metal

proposed in JP,S61-47290,A (patent documents 1), and/or its double salt, Although it had ink absorbency, the water resisting property of a picture, and lightfastness with concomitant use with the weak acid salt of an alkaline metal, and the paints whose secondary [an average of] particle diameter is 0.5-30 micrometers, since paints with big secondary particle diameter needed to be used, gloss and printing density were low.

[0007]

In order to conquer the above faults, many ink jet recording sheets in which particle diameter provided the paints system ink jet receiving layer using detailed paints of 1 micrometer or less are proposed. In JP,H9-183267,A (patent documents 2), the top layer contained colloidal silica and the pore distribution curve has proposed the ink absorbing layer which has a peak in the range which is pore diameters of 2 nm - 100 nm. When the fine-pores peak existed in this range, since ink absorption velocity became quick and used monodisperse colloidal silica with small particle diameter, it was excellent in gloss, and its transparency was also good. However, since colloidal silica did not form secondary particles, its pore volume of the receiving layer was low, and in order to make a lot of ink breathed out absorb, there was a fault that many coating amounts were required. Although the example which has two peaks in this range is indicated in working example of JP,H9-183267,A (patent documents 2), the peak to which this exists an ink absorbing layer at a time in 2 formation beam case in [one] each receiving layer appears. It is not indicated that an electrolyte is included in an ink absorbing layer.

[0008]

In JP,2001-96897,A (patent documents 3), vapor phase method silica and water-soluble metallic compounds were contained, and the ink jet recording material which has an ink absorbing layer whose film surface pH is 3-5 is proposed. vapor phase method silica is an ultrafine particle which a primary particle with a mean particle diameter of 3 nm - 10 nm condenses, and

forms the secondary particle (100 nm - 500 nm) -- small -- since particle diameter, high gloss can be given. Since there is an opening between secondary particles, ink absorbency is also high. However, when such secondary particle diameter uses an ultrafine particle of 1 micrometer or less, since particle diameter is small, a pore diameter becomes small, and since it is a strong capillary tube shrinkage force, there is a manufacturing problem that an ink absorbing layer crocodiles easily in a drying process. Since an ink absorbency extreme fall is caused, it is not preferred to make the addition of binder resin increase, in order to make a capillary tube shrinkage force ease and to prevent a crack. Although addition of water soluble metallic compounds was proposed in the above-mentioned gazette, film surface pH needed to be set to 3-5. vapor phase method silica is boiled markedly, and since it is strong, the capillary tube shrinkage force produced in a drying process compared with wet process silica, Having to use the method of making binder resin construct a bridge with boric acid for manufacturing the receiving layer which does not fully have a crack in addition to a described method, the receiving layer formed by making it such had the fault of becoming weak in intensity and separating under high-humidity/temperature.

[0009]

[Patent documents 1]

JP,S61-47290,A (CLAIMS)

[Patent documents 2]

JP,H9-183267,A (a claim and Table 1)

[Patent documents 3]

JP,2001-96897,A (CLAIMS)

[0010]

[Problem(s) to be Solved by the Invention]

The purpose of this invention solves many problems which said Prior art has, and has the gloss of a photographic-printing-paper tone, It is providing the record sheet for ink jet printers which is excellent in ink absorption

velocity and ink absorption, and moreover does not produce the poor membrane formation by the crack at the time of desiccation in an ink absorbing layer manufacturing process.

[0011]

[Means for Solving the Problem]

In a porous ink receiving layer which has a peak in the range of pore diameter (6 nm - 150 nm) in a pore distribution curve obtained by measurement by the mercury porosimeter, generally, ink can be quickly absorbed according to the strong capillary force, and a clear picture can be acquired. However, in a drying process after coating, a strong capillary tube shrinkage force committed ink absorbing layer coating liquid, and the poor membrane formation by a crack has produced in many cases what only one sharp peak with narrow width does not spread like drawing 2 by a porosity receiving layer of the range of the above [a pore diameter]. There is a tendency which ink absorption is insufficient for absorbing a lot of ink breathed out in an instant in many cases, and ink overflows, or printing density unevenness called beading produces.

[0012]

When this invention persons inquire wholeheartedly, in the range of pore diameter (6 nm - 150 nm) like drawing 1 Two peaks, Or a crack [in / in a porous ink receiving layer which has one broad peak which has a shoulder / a drying process] did not occur, and ink absorption velocity was quick, and it found out that ink absorption also increased. And as a result of examining wholeheartedly how to make the above-mentioned porous ink receiving layer which has such pore distribution form, it found out that it could be made to form by using an electrolyte in addition to minute silica and polyvinyl alcohol which are manufactured by wet process. Since it had big fine pores, if this porous ink receiving layer remained as it was, its gloss was not enough but, and by providing a gloss development layer on it further, high gloss could be given, and it turns out that appearance like outstanding record density and a film photo is acquired, and came to complete this

invention.

[0013]

This invention contains the following mode.

[1] An ink jet recording sheet which provided minute silica manufactured by wet process whose mean particle diameter is 0.5 micrometer or less, and a porous ink receiving layer containing an electrolyte and polyvinyl alcohol at least in one side of a base material, and also provided a gloss development layer in it.

[2] An ink jet recording sheet given in [1] whose 75-degree specular gloss (JIS P8142) is not less than 40%.

[3] An ink jet recording sheet given in [1] this whose base material is a non-infiltrative base material, or [2].

[4] An ink jet recording sheet given in [3] whose 75-degree specular gloss (JIS P8142) of this non-infiltrative base material is not less than 60%.

[5] this -- minute silica -- mean particle diameter -- three -- nm - 100 -- nm -- desirable -- three -- nm - 40 -- nm -- one -- order -- a particle -- condensing -- becoming -- mean particle diameter -- eight -- nm - 500 -- nm -- desirable -- 20 -- nm - 300 -- nm -- two -- order -- a particle -- it is -- [-- one --] - [-- four --] -- either -- a description -- an ink jet recording sheet .

[0014]

[6] An ink jet recording sheet given in either of [1] - [5], wherein specific surface area and pore volume by a nitrogen absorption method of this minute silica fill (the formula 1).
(Formula 1) Specific surface area (m^2/g) $< 730 - 600 \times$ pore volume (ml/g)

[7] An ink jet recording sheet given in [6], wherein specific surface area and pore volume by a nitrogen absorption method of this minute silica fill (the formula 2).

(Formula 2) Specific surface area (m^2/g) $> 450 - 600 \times$ pore volume (ml/g)

[8] An ink jet recording sheet given in [7], wherein specific surface area of this minute silica is furthermore $150 - 300 \text{m}^2/\text{g}$

and pore volume is 0.5 - 0.9 ml/g.

[9] An ink jet recording sheet given in either of [1] - [8] which this minute silica makes condense active silica, and is manufactured.

[10] An ink jet recording sheet given in either of [1] - [9] as which this electrolyte is chosen from alkali metal salt or alkaline earth metal salt and which is a kind at least.

[11] An ink jet recording sheet given in [10] this whose electrolyte is a strong acid salt of an alkaline metal.

[12] An ink jet recording sheet given in either of [1] - [11] whose content of this electrolyte is a rate of 0.05 to 5 mass part to this detailed paints 100 mass part.

[13] An ink jet recording sheet given in either of [1] - [12] whose saponification degrees of polyvinyl alcohol are not less than 90%.

[14] An ink jet recording sheet given in either of [1] - [13] whose degrees of polymerization of polyvinyl alcohol are 1700 or more.

[15] this -- a porous ink receiving layer -- the mercury porosimetry -- having measured -- a pore distribution curve -- setting -- a pole diameter -- six -- nm - 150 -- nm -- the range -- two -- a ** -- a peak -- or -- a shoulder -- having -- one -- a ** -- it is broad -- a peak -- having -- things -- the feature -- carrying out -- [-- one --] - [-- 14 --] -- either -- a description -- an ink jet recording sheet .

[16] An ink jet recording sheet given in [15] whose an absolute value of a difference of a mode pole diameter and a median pole diameter in this pore distribution curve is not less than 10 nm.

[17] An ink jet recording sheet given in [15] whose pore volume in the range of pole diameter (6 nm - 1 micrometer) of this porous ink receiving layer is 0.5 - 2.0 ml/g, or [16].

[18] An ink jet recording sheet given in either of [1] - [17] whose film surface pH of this porous ink receiving layer is 5-10.

[19] An ink jet recording sheet given in either of [1] - [18]

in which pH containing this minute silica, this electrolyte, and polyvinyl alcohol forms this porous ink receiving layer by drying seven or more distemper after coating to a base material.

[0015]

[Embodiment of the Invention]

The formation method of the porous ink receiving layer in this invention is explained. Mean particle diameter hardens 0.5 micrometer or less of wet process minute silica with polyvinyl alcohol, and the porous ink receiving layer of this invention is manufactured. Although a formation method in particular is not limited, it excels in ink absorption velocity and ink absorption, and in order to obtain the porous ink receiving layer which moreover does not produce the poor membrane formation by the crack at the time of desiccation in a manufacturing process, the following methods are used suitably. Polyvinyl alcohol to minute silica 100 mass part One to 100 mass part, The distemper which contains at a rate of five to 20 mass part more preferably, and contains an electrolyte at a rate of 0.05 to 5 mass part 0.01 to 10 mass part three to 28 mass part preferably is applied to a base material, it dries and an ink absorbing layer is formed.

[0016]

The minute silica used in this invention is 0.5 micrometer or less, and particle diameter is distributing it to colloid stably in the above-mentioned distemper. In a drying process, the minute silica surface is adsorbed in the electrolyte which will be contained by the time the concentration of distemper rises and is dried, surface charge quantity decreases, dispersion stability is lost, and a big condensation structure is generated in an operation of polyvinyl alcohol. The opening which exists in this condensation structure is distributed over the range which are 6 nm - 150 nm, and the porous ink receiving layer which, as a result, has two peaks or one broad peak which has a shoulder in the range of pole diameter (6 nm - 150 nm) is formed. Thus, condensation structure generates

under the influence of electrolytic, and when much fine pores with a big path exist, after easing a capillary tube shrinkage force and applying an ink absorbing layer, the crack in a drying process can be prevented.

[0017]

The silica used by this invention is silica chemically compounded by wet process. Silica is divided roughly into the natural silica produced by grinding natural silica, such as quartz, and the synthetic silica manufactured by composition, and synthetic silica is divided roughly into wet process silica and dry process silica. Although the silica by a sedimentation method and the silica by the gel method are known and wet process silica is mentioned later, the silica which makes condense activated silica in addition to this, and is manufactured is also contained. Sedimentation method silica filters the silica which added mineral acid to alkaline silicate solution gradually, and sedimented, for example as indicated by JP,S55-116613,A, and is manufactured. The gel method silica is obtained by washing and grinding, after making an alkaline silicate solution mix and gel mineral acid. Since the character which the primary particle of silica joins together, forms the aggregated particle, has many openings between primary particles and between aggregated particles, therefore ink absorption is large and also is scattered about in light is small and high printing density is obtained, this sedimentation method silica and the gel method silica are preferably used for this invention.

[0018]

It is the silica manufactured by the method of carrying out pyrolysis of the volatile silicon compound in a flame, and is marketed as a granular material with dramatically low bulk density as it is called dry process silica also with vapor phase method silica, for example, is indicated by JP,S59-169922,B. If the water dispersed matter of dry process silica is dried, it will become porous silica gel, Although the pore volume by the nitrogen absorption method of the gel is generally 1.2 -

1.6 ml/g and is convenient for making ink absorb, the crack at the time of desiccation is remarkable, and it is not easy to manufacture an ink absorbing layer without a crack. Condensation structure is not formed, even if polyvinyl alcohol and an electrolyte are added and it manufactures an ink absorbing layer. The direction of the silica of wet process is excellent in this point.

[0019]

The method of condensing and manufacturing activated silica as a little special manufacturing method of wet process silica is known. For example, on the US,2574902,B Descriptions. By preparing active silica solution, making a part of this active silica solution add and stabilize alkali, and polymerizing by processing the dilution-water solution of a sodium silicate with cation exchange resin, and removing sodium ion, The method of making the liquid (seed liquid) which the seed particles of silica distributed, adding the remainder (feeding liquid) of active silica solution gradually to this, polymerizing silicic acid, holding alkali conditions, and growing up the particles of colloidal silica is indicated. Diameters are 3 nm - hundreds of nm, and the silica manufactured by this method does not carry out a secondary aggregation, but, moreover, has the feature that particle size distribution is very narrow. Usually, it is called colloidal silica and the product (7 nm - 100 nm) is marketed as a water dispersion, and if it uses for an ink absorbing layer, a receiving layer with high transparency will be extremely obtained by high gloss. However, since it is not an aggregated particle, in respect of ink absorption, the direction of the above, sedimentation method silica, or the gel method silica is excellent.

[0020]

It is also possible to make activated silica condense and to manufacture the silica having the strong point of sedimentation method silica or the gel method silica and the strong point of colloidal silica, and the silica specifically indicated by JP,H2001-354408,A and JP,H2002-145609,A is

illustrated. This silica is the aggregated particle which the primary particle of silica combined, and since it is easy to adjust secondary particle diameter below on the wavelength of light moreover, and the ink absorbing layer which is excellent in ink absorption and a degree of brilliancy can be manufactured easily, it is most preferably used for this invention.

In JP,H2001-354408,A

"The specific surface area by a nitrogen absorption method by $300\text{m}^2/\text{g}$ - $1000\text{-m}^2/\text{g}$. Pore volume uses as seed liquid the liquid which the silica particle which are $0.4\text{ml} [\text{g}] \text{ } \sim 2.0 \text{ ml/g}$ distributed to colloid, . It is characterized by adding a little feeding liquid which consists of at least one kind chosen from active silica solution and alkoxysilane to this seed liquid every, and growing up a silica particle, after adding alkali in this seed liquid. Manufacturing method of the silica particle dispersion liquid which the silica particle of 0.5 ml/g - 2.0 ml/g distributed [the specific surface area by a nitrogen absorption method / $100\text{m}^2/\text{g}$ - $400\text{m}^2/\text{g}$ and the second / an average of / particle diameter] to colloid in 20 nm - 300 nm , and pore volume. "

[0021]

"The specific surface area by a nitrogen absorption method by $300\text{m}^2/\text{g}$ - $1000\text{-m}^2/\text{g}$. Pore volume uses as seed liquid the liquid which the silica particle which are $0.4\text{ml} [\text{g}] \text{ } \sim 2.0 \text{ ml/g}$ distributed to colloid, A little mixtures of the feeding liquid and alkali which consist of at least one kind chosen from active silica solution and alkoxysilane to this seed liquid every. [whether it adds and] . Or it is characterized by adding this feeding liquid and alkali to small-quantity [every] coincidence, and growing up a silica particle. manufacturing method of the silica particle dispersion liquid which the silica particle of 0.5 ml/g - 2.0 ml/g distributed [the specific surface area by a nitrogen absorption method / $100\text{m}^2/\text{g}$ - $400\text{m}^2/\text{g}$ and the second / an average of / particle diameter] to colloid in 20 nm - 300 nm , and pore volume. "-- it is indicated.

[0022]

"JP, 2002-145609, A The suspension containing the aggregate which consists of silica particles by heating the solution containing at least one sort chosen from active silica and alkoxy silane is formed, next, manufacturing method of the silica particle dispersion liquid characterized by carrying out the wet milling of this suspension after adding a little at least one sort chosen from the solution and alkoxy silane which contain active silica under existence of alkali in this suspension every and growing up the silica particle in suspension. " -- it is indicated.

[0023]

As a gestalt of minute silica, in order to obtain high gloss and a high transparency ink absorbing layer, mean particle diameter shall be 0.5 micrometer or less. Since pore volume is still higher in minute silica being the secondary particles which consist of a primary particle (3 nm - 40 nm) preferably in the primary [an average of] particle diameter of 3 nm - 100 nm, it is desirable. 0.5 micrometer or less of mean particle diameter [8 nm - 499 nm of / 10 nm - 400 nm of] of the secondary particles which these primary particles condensed is not less than 20 nm less than 300 nm preferably. If primary particle diameter and secondary particle diameter are too small, it will become difficult to form the opening which contributes to ink absorption, and there is a possibility that the pore volume of a receiving layer may fall and ink absorbency may fall. There is a possibility that the transparency of a receiving layer will fall if primary particle diameter and secondary particle diameter are too large, and printing density and gloss may fall. All the primary particle diameter as used in the field of this invention is particle diameter (diameter of Martin) observed with the electron microscope (SEM and TEM) . Secondary particle diameter is a value which is measured by dynamic light scattering and computed from the analysis using the KYUMURANTO method.

[0024]

As for the specific surface area and pore volume by a nitrogen absorption method of minute silica, it is desirable to fill the formula 1.

(Formula 1) Specific surface area (m^2/g) $< 730 - 600 \times$ pore volume (ml/g)

This invention persons manufacture the minute silica which has various specific surface areas and pore volume based on JP, H2001-354408, A, When polyvinyl alcohol was added as a binder and the ink absorbing layer was created by coating, as shown in drawing 3, it found out being clearly divided into the field where a haze value is small, and the field where transparency is low namely, where a haze value is high highly [the transparency of an ink absorbing layer]. And the formula showing the boundary line of these two fields was specific surface area (m^2/g) $= 730 - 600 \times$ pore volume (ml/g). That a haze value is high shows that the opening where a pore diameter is big has produced so much. When it used for an ink absorbing layer, condensation was promoted by addition of few electrolytes called 0.05 to 1 mass part to silica 100 mass part, the silica which fills the formula 1 could prevent the crack of the ink absorbing layer, and its ink absorbency was also still better.

[0025]

However, as for the silica with which the specific surface area and pore volume of minute silica fill the formula 3, since ink absorbency is a little inferior, it is more preferred to fill the formula 1 and the formula 2 simultaneously.

(Formula 2) Specific surface area (m^2/g) $> 450 - 600 \times$ pore volume (ml/g)

(Formula 3) Specific surface area (m^2/g) $< 450 - 600 \times$ pore volume (ml/g)

[0026]

Still more desirable minute silica fills the formula 1 and the formula 2 simultaneously, specific surface area is $150 - 300 \text{m}^2/\text{g}$, and pore volume is $0.5 - 0.9 \text{ ml/g}$. The silica in this range is dramatically excellent in the balance of the crack of an

ink absorbing layer, ink absorbency, and gloss.

[0027]

The method of distributing [is ground and] and obtaining by giving strong power to commercial silica (that whose particle diameter is several micrometers - tens of micrometers) by a mechanical means as one of means, although the method in particular of making silica minute silica with a mean particle diameter of 0.5 micrometer or less is not limited is mentioned. That is, it is obtained by the breaking down method (how to subdivide a massive raw material). As a mechanical means, the mechanical techniques, such as an ultrasonic homogenizer, a pressure type homogenizer, a nano mizer, a high velocity revolution mill, a roller mill, a container driving-medium mill, a medium agitation mill, a jet mill, and a Sand grinder, are mentioned. The minute silica obtained may be colloid or may be slurry form.

[0028]

The method by condensation of the active silica currently indicated by JP,2001-354408,A, The minute silica which has above-mentioned particle diameter and pore volume can be manufactured directly, without being based on a mechanical means, and since particle size distribution is narrow and the transparency and the gloss of an ink absorbing layer are good, it can use for this invention preferably. Active silica puts here pH four or less silicic acid solution produced by carrying out ion exchange treatment of the alkali metal silicate solution, for example with hydrogen type cation exchange resin. 1 - 6 mass % is preferred as SiO_2 concentration, and the active silica solution which is two to 5 mass % more preferably, and is pH 2-4 is desirable. As an alkali metal silicate, what can be obtained as a commercial industrial commodity may be used, and it is preferred to use about two to four sodium water glass as a $\text{SiO}_2/\text{M}_2\text{O}$ (however, M expresses alkaline metal atom) mole ratio more preferably.

[0029]

As a condensation method of active silica. [whether the

above-mentioned active silica solution is dropped at hot water, and] Before heating active silica solution, making seed particles generate and dispersion liquid's forming a precipitate, Or add alkali and seed particles are stabilized, before gelling, Subsequently, the silica particle into which active silica solution was converted into SiO_2 to 1 mol of SiO_2 contained in seed particles, it added the speed for 0.001-0.2-mol/preferably, and the primary particle of seed particles was grown up is preferred, maintaining this stable state.

[0030]

As an electrolyte used, although any of inorganic acid, an inorganic base, a salt, organic acid, and an organic base may be sufficient, since there will be few additions and they will end if a strong electrolyte is used, it is desirable. A thing of 0.01g or more has the preferred solubility to 100 g of water at 25 **.

As an example of a desirable electrolyte, sodium sulfate, sodium chloride, sodium hydrogensulfate, Sodium nitrate, sodium acetate, sodium formate, sodium carbonate, Sodium bicarbonate, a sodium dihydrogenphosphate, disodium hydrogenphosphate, Trisodium monophosphate, sodium subsulfite, potassium sulfate, potassium chloride, Potassium bisulfate, potassium nitrate, potassium acetate, potassium formate, potassium carbonate, Potassium bicarbonate, potassium dihydrogen phosphate, the potassium phosphate, Alkali metal salt, such as tripotassium phosphate and potassium thiosulfate, calcium sulfate, A calcium chloride, a calcium nitrate, calcium acetate, formic acid calcium, Calcium carbonate, calcium hydrogen phosphate, calcium primary phosphate, Tricalcium phosphate, barium sulfate, barium chloride, a barium nitrate, Barium acetate, formic acid barium, barium carbonate, hydrogen phosphate barium, Phosphoric acid 2 hydrogen barium, phosphoric acid 3 barium, magnesium sulfate, a magnesium chloride, Alkaline earth metal salt, such as a magnesium nitrate, magnesium acetate, and

magnesium carbonate, a manganese chloride, manganese acetate, formic acid manganese, a cupric chloride, copper sulfate, a cobalt chloride, nickel sulfate, nickel chloride, Aluminum sulfate, sulfurous acid aluminum, thiosulfuric acid aluminum, a polyaluminum chloride, An aluminium nitrate, an aluminium chloride, the ferrous bromide, ferrous chloride, ferric chloride, Although water soluble salts, such as ferrous sulfate, ferric sulfate, a zinc bromide, zinc chloride, zinc nitrate, and sulfate of zinc, lithium hydroxide, sodium hydroxide, a potassium hydrate, calcium hydroxide, strontium hydroxide, barium hydroxide, etc. are mentioned, it is not limited to these. It not only can use these electrolytes alone, but two or more kinds can be mixed and it can use them.

[0031]

Also in this, it can mix to distemper easily and especially alkali metal salt and alkaline earth metal salt tend to cause condensation of paints for distemper in the drying process after coating, and since they can obtain easily the porous ink receiving layer in this invention, they are used suitably. The strong acid salt of an alkaline metal and alkaline-earth metals, i.e., a hydrochloride, sulfate, a nitrate, the phosphate, etc. can exist most stably in distemper, and since they do not sediment in alkalinity, they are used most suitably. Sodium sulfate, sodium chloride, sodium nitrate, potassium sulfate, potassium chloride, potassium nitrate, a calcium chloride, calcium sulfate, a calcium nitrate, etc. can be illustrated. The hydrochloride of an alkaline metal, sulfate, and a nitrate are especially preferred.

[0032]

Although the weak acid salt of the alkaline metal is used also for JP, S61-47290, A, the point restricted to the weak acid salt and the point that the secondary particle diameter of paints currently used is as large as 0.5-30 micrometers differ from this invention. In this invention, condensation of particles is caused in a drying process, electrolytes, such as water soluble salts, are used in order to prevent a crack, and it

is not restricted to the weak acid salt in particular of an alkaline metal.

[0033]

In JP,2001-96897,A, although vapor phase method silica and water-soluble metallic compounds are used, the point that the paints to be used are vapor phase method silica, and the point that film surface pH is acidic regions of 3-5 differ from this invention. In the point that the minute silica and the electrolyte by wet process are used together, and the point that alkali metal salt is preferably used as an electrolyte, this invention differs from JP,2001-96897,A for which polyvalent metallic salt is used. Film surface pH of the porous ink receiving layer in this invention differs also in a point or more with preferred five from JP,2001-96897,A. It is about ten, although it is preferred that it is five or more although film surface pH in particular of the porous ink receiving layer of this invention is not limited and there is no maximum in particular. When film surface pH is kept or more at five, a crack is preferred few.

[0034]

The binder resin used is polyvinyl alcohol. Since the crack of an ink absorbing layer occurs and ink absorbency is not good, either, even if it uses binder resin other than polyvinyl alcohol, it cannot be used. Although a good Reason is not clear in polyvinyl alcohol, a moderate interaction with silica occurs and it thinks for making silica condense according to a synergistic effect with water soluble salt.

[0035]

Not less than 90% of especially the saponification degree of polyvinyl alcohol is desirable, and is the most desirable. [not less than 95 more% of] The one where a saponification degree is higher has few cracks of an ink absorbing layer, and the ink absorbency of the one is also good. The direction of polyvinyl alcohol (PVA) of a high saponification degree containing many hydroxyl groups interacts with silica more strongly, and the Reason is considered for promoting

condensation. 1700 or more are preferred, it is 2500 or more more preferably, and a degree of polymerization is 3500 or more most preferably. It is about 10000 although there is no maximum in particular. The crack of an ink absorbing layer has little one where a degree of polymerization is higher.

[0036]

Although pH in particular of the distemper in this invention is not limited, adjusting pH or more to eight preferably seven or more is used suitably to obtain the ink jet receiving layer of this invention, in order to promote generation of a big condensation structure in a drying process. It is about ten although there is no maximum in particular in pH. Although not limited, especially the regulating method of pH has a simple method of adding ammonia, sodium hydroxide, and a potassium hydrate to this distemper, is effective for it, and is used suitably. [of a method]

[0037]

According to the purpose, various additives are used besides minute silica, polyvinyl alcohol, and an electrolyte. For example, cationic resin as an ink fixing agent is mentioned. As an example of cationic resin, the fourth class of N and N-dimethylamino ethyl acrylate ghost, The fourth class of N and N-dimethylaminoethyl methacrylate ghost, the fourth class of N,N-dimethylaminopropyl acrylamide ghost, Resin including the structural unit which has cationicity, such as vinylimidazo RIUMUMETO chloride, diaryl dimethylammoniumchloride, a methyl di allylamine salt, diaryl amine salt, monoallyl amine salt, and an amidine ring, is mentioned. When mixing these cationic resin to the dispersion liquid of anionic paints, such as silica, and adding, a paint is temporarily gelled for both electrostatic characteristic, but it becomes usable by carrying out re dispersion using the mechanical means of a homogenizer etc. It is also possible as a cationic substance to blend alumina sol etc. However, since addition of cationic resin tends to worsen the crack of an ink absorbing layer, after addition forms an ink absorbing layer,

it is preferred [addition] to include the solution of cationic resin in an ink absorbing layer by the method of being applied or impregnated.

[0038]

In addition, as an additive, the ultraviolet ray absorbent for auxiliary agents, such as the dispersing agent used for common coated paper manufacture, a thickener, a defoaming agent, colorant, a spray for preventing static electricity, and a wetting agent, and the improvement in preservability of a printing image and a SadamuMitsuyasu-sized agent can be added suitably.

[0039]

Although the base material in particular in this invention is not limited, paper or a film, For example, polyethylene terephthalate, polyvinyl chloride, polycarbonate, Polyimide, cellulose triacetate, cellulose diacetate, Since it will be easy to obtain the ink jet recording sheet of high gloss if non-infiltrative base materials, such as synthetic resin laminated papers, such as synthetic resin films, such as polyethylene and polypropylene, or a polyethylene laminated paper, are used, it is desirable. The 75-degree specular gloss of a non-infiltrative base material is not less than 100% not less than 80% not less than 60% preferably. The 75-degree specular gloss in this invention is measured according to JIS P8142.

[0040]

These base materials can give an under coat, when adhesive strength with the ink absorbing layer formed in the surface is insufficient, or they can perform easily-adhesive processing of various kinds, such as corona discharge treatment. As for the thickness of a base material, when the paper feeding efficiency of a printer is taken into consideration, 50-500 micrometers is preferred.

[0041]

A coating means publicly known as a coating method of the distemper in this invention, for example, the BAKOTINGU method,

Although the roll coating method, a braid coating method, the air-knife-coating method, the gravure coating method, a die coating method, the curtain coating method, etc. can be used, it does not restrict to these.

[0042]

A 1 - 50 g/m² grade is desirable still more preferred as mass after desiccation, and the coating amount of an ink absorbing layer is 3 - 25 g/m². If there is a possibility that absorbing of ink may become insufficient when less than 1 g/m² here, and it increases more than 50 g/m², there will be a possibility of becoming easy to generate curl and cost will also increase.

[0043]

Next, the pore distribution measurement by the mercury porosimetry is explained. Pore distribution is Micrometrics. Pore distribution was calculated and searched for using the pore sizer 9320 (Made by Shimadzu) from the amount distribution curve of openings searched for with the method of mercury penetration. Measurement of the pore diameter by a method of mercury penetration calculated the section of fine pores using the following formula drawn by assuming as circular.

[0044]

$D = -4\gamma \cos \theta / P$

However, D: pore diameters, the surface tension of γ :mercury, θ :angle of contact, P: Consider it as a pressure.

Making surface tension of mercury into 482.536 dyn/cm, the use angle of contact was 130 degrees, and performed high pressure part measurement (0 - 30000psia, measurement pore diameter of 6 micrometers - 6 nm). The average pore volume of an ink absorbing layer is calculated from the mass and the amount distribution curve of openings of an ink absorbing layer which were measured beforehand. In the pore distribution curve of the ink absorbing layer in this invention, in order that it might have a peak in the range of 6 nm - 150 nm and the foot of a peak might reach to 1 micrometer in many cases, it integrated and asked for the pore volume in the range which

are 6 nm - 1 micrometer.

[0045]

Next, an indispensable porous ink receiving layer is explained to this invention. Mean particle diameter has a porous ink receiving layer containing minute silica, and the electrolyte and polyvinyl alcohol of the wet process which is 0.5 micrometer or less, and the porous ink receiving layer in this invention is formed by the above-mentioned method. In order to realize the ink jet recording sheet which is excellent in the ink absorption velocity and ink absorption which are the feature of this invention, and moreover does not produce the poor membrane formation by the crack at the time of desiccation in a manufacturing process, As for this porous ink receiving layer, it is preferred to have the following features in pore distribution. That is, the pore distribution curve obtained by measurement by the above-mentioned mercury porosimetry has two peaks or one broad peak which has a shoulder in the range of pore diameter (6 nm - 150 nm) like drawing 1. It is preferred that one broad peak which one of peaks are in the range which are 8 nm - 25 nm between two peaks, or has a shoulder is covering even the range which are 8 nm - 25 nm. Since the fine pores of this range have strong capillary force, they have the advantage that the ink breathed out is absorbable in an instant, but there is also a fault of being easy to produce the poor membrane formation by a crack in the drying process of an ink absorbing layer. However, although it has another fine-pores peak in the range of pore diameter (6 nm - 150 nm) further, or the number of peaks is one, if it has the feature that it is broad, When much fine pores with a big path exist, a capillary tube shrinkage force is eased and the crack of the ink absorbing layer in a drying process can be prevented. The pore volume which contributes to ink absorption when much fine pores with a big path exist can increase, a lot of ink once absorbed by the fine pores in the range which are 8 nm - 25 nm can be incorporated immediately, and ink can be absorbed, without overflowing, even if ink is breathed out one after another.

[0046]

Although the example which has two peaks in this range also in working example of JP,H9-183267,A is indicated, the peak to which this exists an ink absorbing layer at a time in 2 formation beam case in [one] each receiving layer appears. On the other hand by the porous ink receiving layer in this invention. It has two peaks or one broad peak which has a shoulder in the range of pole diameter (6 nm - 150 nm) about the inside of at least one receiving layer, and differs from the JP,H9-183267,A invention in that two peaks exist in one layer of receiving layers.

[0047]

When the peak of a pole diameter exists only in the range below 6 nm, sufficient ink absorption velocity is not obtained but there is a possibility that the printing density unevenness called ink overflow and beading may arise. Ink spreads easily and the receiving layer which exists only in the range in which the peak of a pole diameter exceeds 150 nm has a possibility that a clear picture may not be acquired. Transparency falls, printing density falls and there is a possibility that a glossy sense may also be lost.

[0048]

In the pore distribution curve of this porous ink receiving layer measured by the aforementioned method, it is preferred that the absolute value of the difference of a mode pole diameter and a median pole diameter is over 20 nm not less than 10-nm more preferably. A peak becomes broad, so that the difference of a mode pole diameter and a median pole diameter is large, and a shoulder comes to be accepted clearly, dissociates as a peak with a clear shoulder eventually, and becomes two peaks. Since the peak in a pore distribution curve turns into one sharp peak, there is no dispersion in the size of fine pores and a capillary tube shrinkage force is hard to be eased, when smaller than 10 nm, when carrying out spreading desiccation of the ink absorbing layer, there is a possibility that a crack may arise. Although it is infinite to the value

of a difference, about less than 100 nm is preferred.

[0049]

The pore volume in the range of pore diameter (6 nm - 1 micrometer) of this porous ink receiving layer measured by the aforementioned method is 0.6 - 1.5 ml/g more preferably 0.5 to 1.8 ml/g 0.5 to 2.0 ml/g. If pore volume with a pore diameter of 6 nm - 1 micrometer is larger than 0.5 ml/g, the ink absorbing layer can fully absorb a lot of ink breathed out, and a picture will not be confused by ink overflow. On the other hand, it excels in the fixability of a color that pore volume with a pore diameter of 6 nm - 1 micrometer is 2.0 or less ml/g, and excels also in the intensity of an ink absorbing layer.

[0050]

In this invention, the ink jet recording sheet which has the high gloss of a photographic-printing-paper tone has been obtained by providing a gloss development layer on an above-mentioned porous ink receiving layer. Although the method in particular of providing a gloss development layer is not limited, it has the gloss of a photographic-printing-paper tone, and in order to have high ink absorption velocity and ink absorption, the following two kinds of modes are used suitably.

[0051]

The 1st mode dries after coating the coating liquid containing detailed paints on the porous ink receiving layer in this invention, and is 1 formation beam thing at least about a gloss development layer. Although various paints can be used as detailed paints, pore volume of mean particle diameter is large, and 1 micrometer or less of silica, aluminium hydroxide, boehmite, quasi-boehmite, and alumina excel [mean particle diameter] in ink absorbency. Since pore volume is still higher in detailed paints being the aggregated particles which consist of a 6-40-nm primary particle preferably in the first [an average of] particle diameter of 5-100 nm, it is desirable. 1 micrometer or less of mean particle diameter [9-800 nm of / 10-600 nm of] of the aggregated particle which these primary

particles condensed is 15-400 nm preferably.

Gloss is excellent especially when colloidal silica is used.

[0052]

Although water dispersibility resin and a water soluble polymer can be used as binder resin contained in the above-mentioned coating liquid, a water soluble polymer is preferred. As an example, polyvinyl alcohol, polyethylene oxide, polyalkylene oxide, A polyvinyl pyrrolidone, a water-soluble polyvinyl acetal, a Polly N-vinylacetamide, Polyacrylamide, poly acryloyl morpholine, polyhydroxy alkyl acrylate, Water soluble resin and these water-soluble derivatives, such as polyacrylic acid, hydroxyethyl cellulose, methyl cellulose, hydroxypropylmethylcellulose, hydroxypropylcellulose, gelatin, and casein, are mentioned. Although water dispersibility resin, such as SBR latex and NBR latex, can also be used, water soluble resin is preferred. It not only can use these resin alone, but two or more kinds can be mixed and it can use it.

[0053]

A 0.5 - 10 g/m² grade is desirable still more preferred as mass after desiccation, and the coverage of a gloss development layer is 2 - 8 g/m². When there is a possibility that the manifestations of gloss may run short when less than 0.5 g/m² here, and it increases more than 10 g/m², there is a possibility that the crack at the time of desiccation may arise.

[0054]

In using silica as detailed paints in a gloss development layer, The silica which carried out cation denaturation in order to raise ink fixability is also used suitably, For example, the dispersion liquid which contain fumed silica and a cation compound in JP, 2001-80204, A by a mechanically ground. The ink jet recording sheet which combines high gloss and high printing density has been obtained by carrying out coating of the coating liquid containing the slurry like mixture distributed or ground to the mean particle diameter of 1 micrometer or less.

[0055]

The 2nd mode is the method of providing the gloss development layer (it is called a cast coating layer below) by a cast method. the cast drum (the metal which carried out mirror finish.) which has smooth nature for a coating layer with a cast method By drying in tops, such as drums, such as a plastic and glass, a metal plate which carried out mirror finish, a plastic sheet, a film (the film transfer cast method, film cast method), a glass plate, and copying a smooth side on a coating layer, it is smooth and is the method of obtaining the glossy coating layer surface. As a method of providing a cast coating layer using a mirror plane drum, Coating of the coating liquid for cast coating layers is carried out on the porous ink receiving layer in this invention, The method (the RIWETTO cast method) of welding by pressure and drying to the method (the wet cast method) of welding by pressure and drying to the mirror plane drum heated while this coating layer was in the damp or wet condition, and making it, or the mirror plane drum which was once dried and carried out re-humidity and by which afterbaking was carried out, and making it, etc. can be illustrated. After carrying out coating of the coating liquid for direct cast coating layers to the heated mirror plane drum, the method (the pre cast method) of welding by pressure and drying to the porous ink receiving layer side of this invention, and making it is also employable.

[0056]

As for the skin temperature of a mirror plane drum, about 40-200 ** is preferred, and its 70-150 ** is more preferred. Desiccation takes time as it is less than 40 **, there is a possibility that gloss may fall, and there is a possibility that productivity may fall. Exceeding 200 **, if high, it may be ruined, or gloss may fall.

[0057]

When welding by pressure and drying to the mirror plane drum heated while coating of the coating liquid for cast coating layers was carried out on the porous ink receiving layer of this invention and the ink absorbing layer was in the damp or

wet condition and making it, in order to suppress osmosis of the coating liquid for cast coating layers, The method of promoting the immobilization of the coating liquid for cast coating layers can also be taken. . As this method, blend the gelling agent which promotes the immobilization of the coating liquid for cast coating layers for example, into (1) porous ink receiving layer. (2). Do coating and being impregnated of the gelling agent which promotes the immobilization of the coating liquid for cast coating layers on a porous ink receiving layer. (3) After carrying out coating of the coating liquid for cast coating layers, blending the gelling agent by which immobilization is promoted in the process in which coating liquid dries on the surface the gelling agent which promotes the immobilization of the coating liquid for cast coating layers in coating and the coating liquid for (4) cast coating layers with which it impregnates is mentioned. As such a gelling agent, those salts, such as way acid, formic acid, etc. which are the cross linking agents of the adhesives in the coating liquid for cast coating layers, an aldehyde compound, an epoxy compound, etc. are mentioned. When adopting the wet cast method among the above-mentioned methods, coating of the cast coating liquid is carried out on a porous ink receiving layer, and since osmosis of coating liquid is suppressed for the direction which, if possible, shortened time until it welds by pressure to mirror plane drum lifting and dries, it is easy to reveal gloss. The method (a nip cast method is called) which gives cast coating liquid and welds it by pressure promptly between the porous ink receiving layer side on pressure welding rolls (press roll) and a mirror plane drum just before a porous ink receiving layer side is welded by pressure to a drum, It is [that osmosis of coating liquid is suppressed as much as possible, and good gloss and printing quality are easy to be acquired with a small coating amount] especially desirable.

[0058]

Although the coating liquid for cast coating layers in particular is not limited, the coating liquid containing the

polymer which makes the monomer which has an ethylenic unsaturated bond come to polymerize and which has a not less than 40 ** glass transition point preferably can be illustrated as indicated by JP,H07-089220,A, for example. As a polymerizing polymer, the monomer (henceforth an ethylenic monomer) which has an ethylenic unsaturated bond, For example, methyl acrylate, ethyl acrylate, butyl acrylate, 2 ethylhexyl acrylate, laurylacrylate, 2-hydroxyethyl acrylate, The acrylic ester whose alkyl group carbon numbers, such as glycidyl acrylate, are 1-18 pieces, Methyl methacrylate, ethyl methacrylate, 2-hydroxyethyl methacrylate, The methacrylic acid ester whose alkyl group carbon numbers, such as 2-hydroxypropyl methacrylate and glycidyl methacrylate, are 1-18 pieces, It is a polymer produced by polymerizing ethylenic monomers, such as styrene, alpha-methylstyrene, vinyltoluene, acrylonitrile, VCM/PVC, a vinylidene chloride, vinyl acetate, vinyl propionate, acrylamide, N-methylolacrylamide, ethylene, and butadiene. It may be the copolymer which used together two or more kinds of ethylenic monomers if needed, and copolymerization of other monomers can be carried out. Also in the above, a styrene acrylic ester copolymer and a styrene methacrylic-acid-ester copolymer are especially preferred.

[0059]

Furthermore, the substituted derivative of these polymers or a copolymer may be sufficient as a polymer. Incidentally, as a substituted derivative, the thing carboxyl-group-ized, for example or the thing which made it alkaline reaction nature is illustrated. It is also possible to use it in the form which polymerized the above-mentioned ethylenic monomer under existence of colloidal silica, and became a complex by Si-O-R (R: polymer component) combination. The glass transition point of a not less than 40 ** thing is preferred, and the polymer which polymerizes the above-mentioned ethylenic monomer has that desirable whose ranges are about 50 ** - about 100 ** more preferably. They are about 70 ** - about 90 ** most preferably. A glass transition point can be adjusted with the bridge

construction degree of the kind of for example, ethylenic monomer, or a polymer. For example, a glass transition point can be made high by making monomers, such as styrene which makes a glass transition point high in comparison, more than 50 mass % contain. Into the coating liquid for cast coating layers, paints other than the above-mentioned polymer, such as colloidal silica, can be blended, and the quantity usually has about 1 mass part - about 200 preferred mass parts to polymer 100 mass part. Urethane resin can also be used.

[0060]

In order to adjust a whiteness degree, viscosity, mobility, etc. in the coating liquid for cast coating layers, various auxiliary agents, such as the paints currently used for the general coated paper for printing and inkjet printing paper, a defoaming agent, colorant, a fluorescent brightener, a spray for preventing static electricity, an antiseptic and a dispersing agent, and a thickener, are added suitably. It is preferred to add a release agent in order to give the mold-release characteristic from a cast drum etc. into the coating liquid for cast coating layers.

As a release agent, higher fatty acid amide, such as octadecanamide and oleic amide, Polyolefine waxes, such as polyethylene wax, oxidized polyethylene wax, and polypropylene wax. Fluorine compounds, such as silicone compounds, such as higher-fatty-acid alkali salt, such as calcium stearate, zinc stearate, oleic acid potassium, and oleic acid ammonium, lecithin, silicone oil, and silicone wax, and polytetrafluoroethylene, are mentioned. The loadings of a release agent are more preferably adjusted in the range of 0.5 to 20 mass part 0.3 to 30 mass part 0.1 to 50 mass part to paints 100 mass part. There is a possibility that the effect of a mold-release characteristic improvement may not fully be acquired if there are few loadings here, and if large, gloss may fall conversely, or HAJIKI of ink and the fall of record density may arise.

[0061]

It is also possible to combine the 1st mode and 2nd mode. That is, on the porous ink receiving layer in this invention, according to the first mode, the coating liquid containing detailed paints can be dried after coating, much more gloss development layer can be provided at least, and the gloss development layer by a cast method can be further provided according to the 2nd mode. Gloss is good to things in this method.

[0062]

Not less than 40% is not less than 50% desirable still more preferably, and the 75-degree specular gloss of the ink jet recording sheet of this invention which provided the gloss development layer by the above methods is not less than 70% most preferably.

[0063]

With the ink absorbing layer on a base material, a back layer can also be provided in an opposite hand for curl control of an ink jet recording sheet, and improvement in conveyance nature. Although the composition of a back layer and the base material rear face accompanying it can be chosen according to the use and it is not limited in particular, if an example is taken in coating nature and cost, it is preferred to provide the back layer which uses hydrophilic resin as the main ingredients. An adhesive layer and an exfoliation sheet may be provided in a rear face.

[0064]

[Example]

Although working example is given below and this invention is explained concretely, this invention is not limited by these working example from the first. It is this example, and especially "%" that expresses concentration unless it refuses, mass % is meant and a "part" means a mass part.

[0065]

[Pore volume of silica, and a measuring method of a pore diameter]

It measured, after carrying out the vacuum deairing of the pore volume and pore volume distribution of a powder sample which

were acquired by drying the water dispersion of silica at 105 °C at 200 °C as pretreatment for 2 hours using gas absorption method specific surface area and a pore distribution measuring device (product SA made by Coulter 3100plus type). Nitrogen was used as adsorption gas. Pore volume used the value of the whole pore volume of fine pores with a pore diameter of 100 nm or less. The pore diameter was made into the pore diameter of the maximum volume fraction in the pore distribution curve called for from the analysis by the BJH method of a desorption constant temperature line.

[0066]

[A second [an average of] particle diameter measuring method of silica]

Using the laser particle size meter (the Otsuka Electronics Co., Ltd. make, LPA3000/3100) by dynamic light scattering, where the water dispersion of silica is fully diluted with distilled water, it measured. Mean particle diameter used the value computed from the analysis which used the KYUMURANTO method.

[0067]

[A manufacturing method of the minute silica dispersion liquid A]

synthetic amorphous silica (the product made by Grace DEBISON.) with a mean particle diameter of 13.1 micrometers manufactured by the gel method Trade name : The silo jet P612, specific surface area 290m²/g, The slurry which carried out moisture powder of the primary particle diameter of 9 nm by 20% of concentration, added the ammonia solution, and adjusted pH to 9.0, Grinding dispersion was repeatedly carried out by the horizontal-type bead mill (the product made from SHIMMARU Enterprises, die no mill KDL-Pilot), and the 20% water dispersion of silica with a particle diameter [second / an average of] of 300 nm was manufactured. the specific surface area of these silica detailed paints came out of 290m²/g and pore volume 0.7 ml/g.

[0068]

[A manufacturing method of the minute silica dispersion liquid B]

(Preparation of active silica solution)

30% of SiO_2 concentration, the sodium silicate solution of SiO_2 / Na_2O mole ratio 3.1 Distilled water was mixed to [Tokuyama Make and the No. 3 sodium silicate], and the rare sodium silicate solution of 4.0% of SiO_2 concentration was prepared. About this solution, it is hydrogen type cation exchange resin. Active silica solution was prepared through the column with which it filled up with [the Mitsubishi Chemical make and diagram ion SK-1BH]. The SiO_2 concentration in the obtained active silica solution was 4.0%, and pH was 2.9.

(Preparation of seed liquid)

400 g of distilled water was warmed at 100 °C in the 5-l. glass reaction vessels provided with the dephlegmator, the agitator, and the thermometer. Keeping this hot water at 100 °C, a total of 480g of the above-mentioned active silica solution was added the speed for 8g/, and seed liquid was prepared.

(Preparation of minute silica dispersion liquid)

To the above-mentioned seed liquid, it added at a stretch and the potassium hydroxide solution 13.5g with a concentration of 1 mol/l. was stabilized. 920 moreg of the above-mentioned active silica solution was added the speed for 8g/, keeping this seed liquid at 100 °C. After the end of addition, it kept at 100 °C, heating flowing back was performed for 1 hour, and minute silica dispersion liquid were obtained. Dispersion liquid were a transparent solution of light opalescence, and pH was 8.6. The description of these minute silica dispersion liquid was 13.5 nm in second [an average of] particle diameter [of 99 nm], primary-particle-diameter [of 14 nm], and specific surface area 193m²/g, pore volume 0.62 ml/g, and pole diameter. These dispersion liquid are condensed to 20% of silica concentration by an evaporator, and it is hydrogen type cation exchange resin. After supplying and stirring [the Mitsubishi Chemical make and diagram ion SK-1BH] and removing a potassium hydrate, the ammonia solution adjusted the pH to

9.0 and it used for manufacture of an ink jet recording sheet.
[0069]

[A manufacturing method of the minute silica dispersion liquid C]

silica (the product made from Japanese Aerosil.) with a particle diameter [first / an average of] of 20 nm manufactured by the gaseous phase method Trade name : After it carries out moisture powder of AEROSIL130 by 20% of concentration and chloride adjusts pH to 2.5, a hydraulic ultra-high pressure homogenizer (the product made from ***** Industry, micro sieve TAIZA M110-E/H) distributes 3 times, The 20% water dispersion of silica with a particle diameter [second / an average of] of 250 nm was manufactured. The specific surface area of these silica detailed paints was $137\text{m}^2/\text{g}$, and pore volume was 1.2 ml/g.

[0070]

[A manufacturing method of the cation denaturation minute silica dispersion liquid D]

the 11% water dispersion of silica (product [made from Japanese Aerosil], and trade name: AEROSIL300) with a particle diameter [first / an average of] of 9 nm manufactured by the gaseous phase method -- silica -- sol -- the hydraulic ultra-high pressure homogenizer used with the manufacturing method of C distributed 3 times. The specific surface area of this minute silica was $308\text{m}^2/\text{g}$, and pore volume was 1.6 ml/g. the diaryl dimethylammoniumchloride acrylamide copolymer (the Nitto Boseki Co., Ltd. make.) which is cation resin as an ink fixing agent at these 100 copies of dispersion liquid Trade name : P Ten copies of 11% solution of AS-J-81 was added, distribution was further repeated for the gelled mixture with the homogenizer, and the silica water dispersion with a particle diameter [second / an average of] of 100 nm was manufactured. These dispersion liquid were 11% of solids concentration, and the silica concentration was 1% in diaryl dimethylammoniumchloride acrylamide copolymer concentration 10%.

[0071]

[A manufacturing method of the coating liquid E for cast coating layers]

The styrene 2-methylhexyl acrylate copolymer resin of 85 ** of glass transition points, It carried out as 100 copies and a viscosity controlling agent in five copies of alkyl vinyl ether maleic acid derivative resin, three copies of lecithin was mixed and distributed for 50:50 complexes of colloidal silica with a mean particle diameter of 30 nm in water as a release agent, and the coating liquid for cast coating layers of 10% of solids concentration was manufactured.

[0072]

[A manufacturing method of the minute silica dispersion liquid F]

Silica with specific surface area almost same by the same method as the minute silica dispersion liquid B and big pore volume was manufactured. Activated silica and the manufacturing installation which were used are the same.

In glass reaction vessels, 400 g of distilled water was warmed at 100 **. Keeping this hot water at 100 **, a total of 1120g of the above-mentioned active silica solution was added the speed for 16g/, and seed liquid was prepared.

To the above-mentioned seed liquid, it added at a stretch, and the potassium hydroxide solution 27g with a concentration of 1 mol/l. was carried out, and was stabilized. 1760 moreg of the above-mentioned active silica solution was added the speed for 16g/, keeping this seed liquid at 100 **. After the end of addition, it kept at 100 **, heating flowing back was performed for 1 hour, and minute silica dispersion liquid were obtained. Dispersion liquid were a transparent solution of light opalescence, and pH was 8.8. The descriptions of these minute silica dispersion liquid were second [an average of] particle diameter [of 154 nm], primary-particle-diameter [of 14 nm], and specific surface area 198m²/g, and pore volume 1.10 ml/g. These dispersion liquid are condensed to 20% of silica concentration by an evaporator, and it is hydrogen type

cation exchange resin. After supplying and stirring [the Mitsubishi Chemical make and diagram ion SK-1BH] and removing a potassium hydrate, the ammonia solution adjusted the pH to 9.0 and it used for manufacture of an ink jet recording sheet.
[0073]

[A manufacturing method of the minute silica dispersion liquid G]

Silica with specific surface area almost same by the same method as the minute silica dispersion liquid B and small pore volume was manufactured. Activated silica and the manufacturing installation which were used are the same.

In glass reaction vessels, 400 g of distilled water was warmed at 100 **. Keeping this hot water at 100 **, a total of 360g of activated silica was added the speed for 16g/, and seed liquid was created.

To this seed liquid, it added at a stretch and the potassium hydroxide solution 9g with a concentration of 1 mol/l. was stabilized. A total of 560 moreg of activated silica was added the speed for 16g/, keeping this seed liquid at 100 **. After the end of addition, it kept at 100 **, heating flowing back was performed for 1 hour, and minute silica dispersion liquid were prepared. Dispersion liquid were a transparent solution tinged with thin blueness, and pH was 8.8. The descriptions of these minute silica dispersion liquid were second [an average of] particle diameter [of 51 nm], primary-particle-diameter [of 14 nm], and specific surface area 190m²/g, and pore volume 0.35 ml/g. These dispersion liquid are condensed to 20% of silica concentration by an evaporator, and it is hydrogen type cation exchange resin. After supplying and stirring [the Mitsubishi Chemical make and diagram ion SK-1BH] and removing a potassium hydrate, the ammonia solution adjusted the pH to 9.0 and it used for manufacture of an ink jet recording sheet.

[0074]

[Manufacture of base material stencil paper]

The needle-leaved tree bleached kraft pulp (NBKP) in which CSF

(JIS P-8121) carried out beating to 250 ml, and the broad-leaved tree bleached kraft pulp (LBKP) in which CSF carried out beating to 280 ml were mixed at a rate of the mass ratio 2:8, and the pulp slurry of 0.5% of concentration was prepared. 0.1% of anion-ized polyacrylamide resin and 0.7% of a polyamide polyamine epichlorohydrin resin are added 2.0% of cation-ized starch, and alkyl ketene dimer 0.4% to pulp absolute dry mass in this pulp slurry, and it fully stirred and was made to distribute. Paper making of the pulp slurry of the above-mentioned presentation was carried out by the long network machine, and the stencil paper of through, basis weight 180 g/m², and bulk density 1.0 g/cm³ was manufactured for a dryer, size press, and a machine calendar. The size pressing liquid used for the above-mentioned size press process mixed carboxyl denaturation polyvinyl alcohol and sodium chloride with the mass ratio of 2:1, this was added to water and it carried out heating and dissolving, it is what was prepared to 5% of concentration, and it totaled this to both sides of paper, applied it 25 cc, and obtained stencil paper.

[0075]

[Manufacture of a base material]

After performing corona discharge treatment to both sides of base material stencil paper, the following polyolefin resin composition 1 which carried out mixture dispersion with the Banbury mixer is made for a coating amount to be on the felt side side of stencil paper to 25 g/m², The polyolefin resin composition 2 (resin composition for rear faces) is made for a coating amount to be on a wire-faces side to 20 g/m², Apply with the melting extruder (melting temperature of 320 **) which has T type die, and carry out the felt side in a mirror plane, and cooling solidification of the wire side is carried out with the cooling roll of a split face, Smoothness (Oken type, J.TAPPINO.5) manufactured 6000 seconds, and opacity (JIS P8138) manufactured 93% of resin coating base material. (Polyolefin resin composition 1) Long chain type low density polyethylene resin (it density-0.926-g/cm⁻³ and) Melt-index

20g/10 minute 35 copy, low density polyethylene resin (it density-0.919-g/cm⁻³ and) Melt-index 2g/10 minute 50 copy, 15 copies of anatase type titanium dioxides (A-220; made by Ishihara Sangyo), 0.1 copy of zinc stearate, 0.03 copy of antioxidant (Irganox1010; made by Ciba-Geigy), 0.09 copy of ultramarine (made in blue-shade ultramarine No.2000; the first transformation), 0.3 copy of fluorescent brightener (UVITEX alumnus; made by Ciba-Geigy)

(Polyolefin resin composition 2) 65 copies of high-density-polyethylene resin (density 0.954 g/cm³, 10 melt-index 20g / minutes), 35 copies of low density polyethylene resin (density 0.924 g/cm³, 10 melt-index 4g / minutes)

[0076]

<Working example 1>

To minute silica dispersion-liquid A100 copy, the solution of sodium chloride 10% 0.5 copy, and the polyvinyl alcohol (Kuraray Make.) whose saponification degree is 98.5% and whose degree of polymerization is 4000 Trade name :P 40 copies of 10% solution of VA-140 was mixed, and to 100 copies of silica, sodium chloride prepared the paint of 17.1% of solids concentration with which 0.25 copy and 20 copies of polyvinyl alcohol are contained, and made concentration 16.0%, adding ion exchange water. The main ingredients of this paint and pH were shown in Table 1. Bar coating of this paint was carried out so that a coating amount might become 20 g/m² with a dry mass on a base material. This tunic was dried at 120 ** and the porous ink receiving layer was provided.

Then, bar coating of the coating liquid which mixed 22 copies for the 10% solution of polyvinyl alcohol whose above-mentioned saponification degree is 98.5% on this ink absorbing layer at the cation denaturation minute silica dispersion-liquid D(11% of concentration) 100 copy was carried out so that a coating amount might become 5 g/m² with a dry mass. This tunic was dried at 120 **, the gloss development layer was provided, and the ink jet recording sheet was

manufactured. The gloss development layer laminating method of this ink jet recording sheet was shown in Table 1, and the following methods estimated the quality of the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet, and it was shown in Table 2.

[0077]

[Measurement of the pore distribution of a porous ink receiving layer]

Measurement of the pore distribution of the porous ink receiving layer in the ink jet recording sheet of working example of this invention and a comparative example was performed as follows using the ink absorbing layer before providing a gloss development layer. Coating of the ink absorbing layer paint was carried out to the PET film, and the sample removed with the knife was measured. Micrometrics Pore distribution was calculated and searched for using the pore sizer 9320 (Made by Shimadzu) from the amount distribution curve of openings searched for with the method of mercury penetration, and it asked for the peak position and the mode pole diameter. It integrated and asked for the pore volume in the range of 6 nm - 1 micrometer from the obtained pore distribution curve. The absolute value of the difference of the number of the peaks of the range of 6-150-nm pole diameter in the receiving layer of each working example and a comparative example, a peak position, a mode pole diameter, a median pole diameter, a mode pole diameter, and a median pole diameter and the pore volume of the range of pole diameter (6 nm - 1 micrometer) were shown in Table 2.

[0078]

[The crack of a porous ink receiving layer]

Evaluation of the crack of the porous ink receiving layer in this invention was visually performed about the ink absorbing layer before providing a gloss development layer, and the following three-stage estimated the crack situation in a sheet (10 cm x 10 cm).

O : with no crack

O : good, although there are several cracks covering 1 mm or more

x: Crocodile, it is in the whole surface and there is a problem practically.

[0079]

[Film surface pH of a porous ink receiving layer]

Film surface pH of the porous ink receiving layer in this invention was set to film surface pH with the value of surface pH measured 30 seconds afterward in accordance with the method of a description about the ink absorbing layer before providing a gloss development layer using distilled water to J.TAPPI paper pulp test-method No.49.

[0080]

A quality evaluation method of an ink jet recording sheet [75-degree specular gloss]

It measured according to JIS P8142.

[0081]

[Ink absorption velocity]

The following methods estimated the ink absorption velocity of the ink jet recording sheet in this invention. It printed cyanogen, 100% magenta, 100% yellow, and each color solid of 100% black 100% to the ink jet recording sheet by the paper recommendation setting-out print mode only for super fine one of the ink jet printer (the product made from EPSON, PM-800C). The PPC sheet was pressed against the printing unit by hand, and it was investigated visually whether ink would transfer or not. Time until transfer is lost was measured and the following three-stage estimated.

O : less than 1 second

O : less than [more than 1 second 30 second]

x: More than 30 second

[0082]

[Ink absorption]

The following methods estimated the ink absorption of the ink jet recording sheet in this invention. Red, 100% green, and

mixed-colors **** of 100% blue were printed 100% with the described method to the ink jet recording sheet, and the following three-stages estimated the existence of ink overflow, and the homogeneity of printing density.

O : there is no ink overflow and homogeneity is also good.

O : concentration is slightly uneven although there is no ink overflow.

x: Ink overflow is seen.

[0083]

<Working example 2>

To minute silica dispersion-liquid A100 copy, the solution of sodium sulfate 10% 0.5 copy, And 40 copies of 10% solution of polyvinyl alcohol of use is mixed in working example 1, Sodium sulfate prepares the paint of 17.1% of solids concentration with which 0.25 copy and 20 copies of polyvinyl alcohol are contained to 100 copies of silica, Except having used the paint of 16.0% of the concentration which added and diluted ion exchange water, the porous ink receiving layer and the gloss development layer were provided by the same method as working example 1, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0084]

<Working example 3>

To minute silica dispersion-liquid A100 copy, the solution of sodium sulfate 10% One copy, and the polyvinyl alcohol (Kuraray Make.) whose saponification degree is 95.0% and whose degree of polymerization is 3500 Trade name :P Mix 40 copies of 10% solution of VA-635, and sodium sulfate to 100 copies of silica 0.5 copy, Polyvinyl alcohol prepared the paint of 17.1% of the solids concentration contained 20 copies, except having used the paint of 16.0% of the concentration which added and diluted ion exchange water, the porous ink receiving layer and the gloss

development layer were provided by the same method as working example 1, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0085]

<Working example 4>

To minute silica dispersion-liquid A100 copy, the solution of sodium carbonate 10% 0.5 copy, And 40 copies of 10% solution of polyvinyl alcohol of use is mixed in working example 1, Sodium carbonate prepares the paint of 17.1% of solids concentration with which 0.25 copy and 20 copies of polyvinyl alcohol are contained to 100 copies of silica, Except having used the paint of 16.0% of the concentration which added and diluted ion exchange water, the porous ink receiving layer and the gloss development layer were provided by the same method as working example 1, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0086]

<Working example 5>

To minute silica dispersion-liquid B100 copy, the solution of sodium chloride 10% One copy, And 40 copies of 10% solution of polyvinyl alcohol of use is mixed in working example 1, Sodium chloride prepares the paint of 17.0% of solids concentration with which 0.5 copy and 20 copies of polyvinyl alcohol are contained to 100 copies of silica, Except having used the paint of 16.0% of the concentration which added and diluted ion exchange water, the porous ink receiving layer and the gloss development layer were provided by the same method as working example 1, and the ink jet recording sheet was

manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0087]

<Working example 6>

To minute silica dispersion-liquid B100 copy, the solution of sodium sulfate 10% Two copies, And 40 copies of 10% solution of polyvinyl alcohol of use is mixed in working example 1, Sodium sulfate prepares the paint of 16.9% of solids concentration with which one copy and 20 copies of polyvinyl alcohol are contained to 100 copies of silica, Except having used the paint of 16.0% of the concentration which added and diluted ion exchange water, the porous ink receiving layer and the gloss development layer were provided by the same method as working example 1, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2. The shoulder of the fine-pores peak in Table 2 exists gently-sloping over 10-20 nm.

[0088]

<Working example 7>

The porous ink receiving layer was provided on the base material like working example 1. Then, on this ink absorbing layer, after using the roll coater and applying the coating liquid E for cast coating layers, it was made to release from mold after desiccation by welding by pressure to the mirror plane drum whose skin temperature is 75 ** immediately, the gloss development layer (cast coating layer) was provided, and the ink jet recording sheet was manufactured. The cast coating amount at this time was solid content mass, and was 5 g/m². The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet

recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0089]

<Working example 8>

The porous ink receiving layer was provided on the base material like working example 2, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0090]

<Working example 9>

The porous ink receiving layer was provided on the base material like working example 3, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0091]

<Working example 10>

The porous ink receiving layer was provided on the base material like working example 4, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0092]

<Working example 11>

The porous ink receiving layer was provided on the base material

like working example 5, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0093]

<Working example 12>

The porous ink receiving layer was provided on the base material like working example 6, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2. The shoulder of the fine-pores peak in Table 2 exists gently-sloping over 10-20 nm.

[0094]

<Working example 13>

The ink jet recording sheet which has a gloss development layer like working example 5 was manufactured except having used the minute silica dispersion liquid F. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0095]

<Working example 14>

The ink jet recording sheet which has a gloss development layer like working example 5 was manufactured except having used the minute silica dispersion liquid G. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH,

and a gloss development layer in Table 2.

[0096]

<Working example 15>

In working example 5, it replaced with one copy of 10% solution of sodium chloride, and the ink jet recording sheet which has a gloss development layer was manufactured like working example 5 except having used one copy of 10% solution of sodium hydroxide. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0097]

<Comparative example 1>

Except not having added sodium chloride, the porous ink receiving layer and the gloss development layer were provided on the base material by the same method as working example 1, and the ink jet recording sheet was obtained. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0098]

<Comparative example 2>

the polyvinyl alcohol (Kuraray Make.) whose saponification degree is 88.0% and whose degree of polymerization is 3500 at minute silica dispersion-liquid A100 copy Trade name :P Mix 40 copies of 10% solution of VA-235, and the paint of 17.1% of solids concentration with which 20 copies of polyvinyl alcohol is contained to 100 copies of silica is prepared, Except having used the paint of 16.0% of the concentration which added and diluted ion exchange water (with no electrolyte addition), the porous ink receiving layer and the gloss development layer were provided by the same method as working example 1, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a

crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0099]

<Comparative example 3>

Except not having added sodium chloride, the porous ink receiving layer and the gloss development layer were provided by the same method as working example 5, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0100]

<Comparative example 4>

The porous ink receiving layer was provided on the base material like the comparative example 1, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0101]

<Comparative example 5>

The porous ink receiving layer was provided on the base material like the comparative example 2, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0102]

<Comparative example 6>

The porous ink receiving layer was provided on the base material like the comparative example 3, the gloss development layer (cast coating layer) was continuously provided like working example 7, and the ink jet recording sheet was manufactured. The quality of Table 1, the pore distribution of a porous ink receiving layer, a crack, film surface pH, and an ink jet recording sheet was shown for the laminating method of the main ingredients of a paint, pH, and a gloss development layer in Table 2.

[0103]

<Comparative example 7>

40 copies of 10% solution of polyvinyl alcohol of the use to minute silica dispersion-liquid C100 copy in working example 1 is mixed, Polyvinyl alcohol prepared the paint of 17.0% of the solids concentration contained 20 copies to 100 copies of silica, and the porous ink receiving layer was provided by the same method as working example 1 except having used the paint of 16.0% of the concentration which added and diluted ion exchange water. Since this receiving layer had produced many large cracks, there were also many portions which separate from a base material, and it was not able to carry out coating of the paint on this. Therefore, a gloss development layer was not able to be provided. Table 1, the pore distribution of a porous ink receiving layer, a crack, and film surface pH were shown for the main ingredients of a paint, and pH in Table 2.

[0104]

[Table 1]

水性塗料の主成分				電解質		塗料の pH	光沢発現層の積層方法
顔料	ポリマー/カーク けん化度	重合度	種類	添加量 (質量部)			
実施例 1	微細シリカ分散液 A	98.5	4000	塩化ナトリウム	0.25	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 2	微細シリカ分散液 A	98.5	4000	硫酸ナトリウム	0.25	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 3	微細シリカ分散液 A	95.0	3500	硫酸ナトリウム	0.5	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 4	微細シリカ分散液 A	98.5	4000	炭酸ナトリウム	0.25	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 5	微細シリカ分散液 B	98.5	4000	塩化ナトリウム	0.5	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 6	微細シリカ分散液 B	98.5	4000	硫酸ナトリウム	1.0	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 7	微細シリカ分散液 A	98.5	4000	塩化ナトリウム	0.25	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 8	微細シリカ分散液 A	98.5	4000	硫酸ナトリウム	0.25	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 9	微細シリカ分散液 A	95.0	3500	硫酸ナトリウム	0.5	8.8	メチル変性微細シリカ分散液 D を塗工
実施例 10	微細シリカ分散液 A	98.5	4000	炭酸ナトリウム	0.25	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 11	微細シリカ分散液 B	98.5	4000	塩化ナトリウム	0.5	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 12	微細シリカ分散液 B	98.5	4000	硫酸ナトリウム	1.0	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 13	微細シリカ分散液 F	98.5	4000	塩化ナトリウム	0.5	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 14	微細シリカ分散液 G	98.5	4000	塩化ナトリウム	0.5	8.7	メチル変性微細シリカ分散液 D を塗工
実施例 15	微細シリカ分散液 B	98.5	4000	水酸化ナトリウム	0.5	9.5	メチル変性微細シリカ分散液 D を塗工
比較例 1	微細シリカ分散液 A	98.5	4000	(添加せず)	0	8.8	メチル変性微細シリカ分散液 D を塗工
比較例 2	微細シリカ分散液 A	88.0	3500	(添加せず)	0	8.6	メチル変性微細シリカ分散液 D を塗工
比較例 3	微細シリカ分散液 B	98.5	4000	(添加せず)	0	8.7	メチル変性微細シリカ分散液 D を塗工
比較例 4	微細シリカ分散液 A	98.5	4000	(添加せず)	0	8.8	メチル変性微細シリカ分散液 D を塗工
比較例 5	微細シリカ分散液 A	88.0	3500	(添加せず)	0	8.6	メチル変性微細シリカ分散液 D を塗工
比較例 6	微細シリカ分散液 B	98.5	4000	(添加せず)	0	8.7	メチル変性微細シリカ分散液 D を塗工
比較例 7	微細シリカ分散液 C	98.5	4000	(添加せず)	0	2.6	メチル変性微細シリカ分散液 D を塗工

メチル変性微細シリカ分散液 D を塗工

[0105]

[Table 2]

	多孔質インク受容層の細孔分布						多孔質インク受容層のひび割れ	多孔質インク受容層の膜面 pH	インク吸収記録シート			インク吸収量
	細孔ビークの数と位置 (nm)	モード細孔径 d1 (nm)	ポア径 d2 (nm)	細孔分布 d1-d2 (nm)	細孔容積 (ml/g)				75° 光沢	インク吸収速度	インク	
実施例 1	2 個 ; 11, 61	61	45	16	0.79		◎	6.1	55	◎	◎	◎
実施例 2	2 個 ; 10, 45	45	33	12	0.71		◎	6.1	58	◎	◎	◎
実施例 3	2 個 ; 10, 63	63	46	17	0.82		◎	6.2	53	◎	◎	◎
実施例 4	2 個 ; 11, 42	42	31	11	0.65		○	6.1	57	○	○	◎
実施例 5	2 個 ; 15, 55	55	41	14	1.06		◎	6.1	60	◎	◎	◎
実施例 6	1 個 ; 44 (肩あり)	44	32	12	0.94		◎	6.5	61	◎	◎	◎
実施例 7	2 個 ; 11, 61	61	45	16	0.79		◎	6.1	78	◎	◎	◎
実施例 8	2 個 ; 10, 45	45	33	12	0.71		◎	6.1	80	◎	◎	◎
実施例 9	2 個 ; 10, 63	63	46	17	0.82		◎	6.2	75	◎	◎	◎
実施例 10	2 個 ; 11, 42	42	31	11	0.65		○	6.1	78	○	○	◎
実施例 11	2 個 ; 15, 55	55	41	14	1.06		◎	6.1	85	◎	◎	◎
実施例 12	1 個 ; 44 (肩あり)	44	32	12	0.94		◎	6.5	87	◎	◎	◎
実施例 13	1 個 ; 39	39	29	10	1.0		○	6.1	64	○	○	◎
実施例 14	2 個 ; 15, 45	45	33	12	0.51		◎	6.1	60	○	○	○
実施例 15	2 個 ; 15, 60	60	44	16	1.10		◎	7.0	60	◎	◎	◎
比較例 1	1 個 ; 13	13	14	1	0.48		×	6.1	28	×	×	×
比較例 2	1 個 ; 16	16	16	0	0.40		×	6.2	27	○	×	×
比較例 3	1 個 ; 21	21	20	1	0.45		×	6.2	24	○	○	○
比較例 4	1 個 ; 13	13	14	1	0.48		×	6.1	37	×	×	×
比較例 5	1 個 ; 16	16	16	0	0.40		×	6.2	37	×	×	×
比較例 6	1 個 ; 21	21	20	1	0.45		×	6.2	33	×	×	×
比較例 7	1 個 ; 11	11	11	0	0.82		×	4.5	評価不能	評価不能	評価不能	評価不能

[0106]

Like each working example of Table 1, it is the features of this invention coating and to dry, to provide a porous ink receiving layer and to provide a gloss development layer on it at a base material about the distemper containing wet process minute silica, an electrolyte, and polyvinyl alcohol. A big condensation structure is formed into a porous ink receiving layer of the effect of water soluble salts, when much big fine pores exist, a capillary tube shrinkage force is eased and the crack of the drying process is prevented. As a result, the porous ink receiving layer of each working example had two peaks or one broad peak which has a shoulder in the range of 6-150-nm pole diameter so that clearly from each working example of Table 2. Compared with the pole diameter of paints, the pole diameter of the receiving layer was large, and it had a broad fine-pores peak in which much big fine pores exist so that it may understand also from the absolute value of the difference of a mode pole diameter and a median pole diameter being not less than 10 nm. Therefore, ink absorption velocity was quick enough and ink absorption was also large. The degree of brilliancy of the ink jet recording sheet was also still higher enough.

[0107]

Since a big condensation structure was not produced for the distemper which does not contain an electrolyte like each comparative example on the other hand when it dries and a porous ink receiving layer is obtained, coating and, the strong capillary tube shrinkage force in the drying process could not be eased, but the receiving layer produced many cracks. Therefore, even if it provided the gloss development layer in the comparative examples 1-6, the degree of brilliancy was low. Since the pole diameter of a receiving layer did not become large since condensation structure is not produced, therefore ink absorption velocity was slow and pore volume was not able

to become large easily, either, so that it may understand also from the number of the fine-pores peaks of the above-mentioned pole diameter range being one, ink absorption also ran short. In the comparative example 7, many big cracks arose, and since it separated from the base material, a gloss development layer was not able to be provided.

[0108]

When describing the influence of the kind of silica, when the minute silica dispersion liquid B which made condense activated silica and were manufactured were used, the pore volume of the ink absorbing layer was the highest, ink absorption is also good and also gloss was also good. This minute silica fills the formula 1 and the formula 2 simultaneously.

(Formula 1) Specific surface area (m^2/g) $<730-600 \times$ pore volume (ml/g)

(Formula 2) Specific surface area (m^2/g) $>450-600 \times$ pore volume (ml/g)

Although the minute silica dispersion liquid F are the silica which made condense activated silica too and was manufactured, the formula 1 does not fill but fills only the formula 2. In this case, the crack was seen somewhat in the ink absorbing layer. The minute silica dispersion liquid G are an example which fills the formula 1 and with which the formula 2 is not filled.

The pore volume of an ink absorbing layer is slightly lower, and ink absorption fell somewhat.

[0109]

[Effect of the Invention]

The ink jet recording sheet of this invention was able to be manufactured without producing the poor membrane formation by the crack which often poses a problem, when detailed paints are used. It has the high gloss of a photographic-printing-paper tone, has high ink absorption velocity and ink absorption, and is suitable as substitution

of a film photo.

[0110]

[Brief Description of the Drawings]

[Drawing 1] The figure of the pore distribution curve of the porous ink receiving layer in this invention. V shows the pore volume of an ink absorbing layer, and D shows the pore diameter of an ink absorbing layer.

[Drawing 2] The figure of the pore distribution curve of the ink absorbing layer which does not contain an electrolyte in an ink absorbing layer but where only one has a peak in the range of 6-150-nm pore diameter (outside of this invention).

[Drawing 3] The specific surface area and pore volume of silica were taken along the vertical axis and horizontal axis of a graph, respectively, and the coat haze value at the time of carrying out coating to a substrate by making each silica into a paint was classified into five steps, and was indicated. The haze value measured what carried out coating of the paint which mixed 20 number of copies of polyvinyl alcohol 140H by Kuraray Co., Ltd. to silica so that 20 g of dry masses might be set to Toray Industries Make [of a substrate], and trade name: lumiler 100-Q80D to $/m^2$ according to JIS K7105.

[Translation done.]